January 1, 2020

Actuarial Valuation Report

Massachusetts Port Authority
Employees' Retirement System

Lawrence B. Stone

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August 15, 2020

Massachusetts Port Authority Employees' Retirement Board
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909

Dear Members of the Board:

Stone Consulting, Inc. has performed a January 1, 2020 actuarial valuation of the Massachusetts Port Authority Employees' Retirement System (MPAERS). This valuation and report were prepared using generally accepted actuarial principles and practices. To the best of our knowledge, this report is complete and accurate, and the assumptions used were chosen by the Retirement Board in conjunction with Stone Consulting Inc.'s recommendations. We believe the assumptions represent a reasonable estimate of anticipated experience of the system. The assumptions and methods used in this valuation satisfy the Actuarial Standards of Practice as set forth by the Actuarial Standards Board.

As part of performing the valuation, Stone Consulting, Inc. was furnished member data by the administrative staff of the MPAERS. Although examined for general reasonableness, the data was not audited by the actuary. In addition, the administrative staff furnished financial statements that were not audited by the actuary or by the plan's auditors.

The funding objective of the plan is to provide for the current cost of benefits (i.e., normal cost) as a level percentage of payroll over time and this objective is currently being realized. The employer contribution rate is determined by adding the normal cost plus a level dollar amortization of the frozen entry age liability. The normal cost is expected to remain at a level percentage of payroll. While the statute which created the MPAERS did not anticipate the effect of assumption or plan changes on the funding schedule, we have amortized over 20 years these effects, consistent with generally recognized actuarial practice.

MPAERS experienced investment gains in calendar 2019 as compared to the assumed valuation interest rate. The return, net of investment expenses, on the market value of assets was 19.64%. The return on the actuarial value of assets was 6.72% versus the prior year valuation's interest assumption of 7.25%. The Massachusetts Port Authority (Authority)'s FY 2021 (July 1, 2020 through June 30, 2021) contribution of $14,641,803 is $2,612,705 more than the Authority's FY 2020 contribution and $648,197 less than the expected contribution based upon last year's actuarial valuation. The decrease is mainly due to investment gains and recognition of compensation limits under section 401(a)(17) and Section 23 of Chapter 131 of the Acts of 2010 offset in part by changes in actuarial assumptions. There was also a small actuarial loss (under the frozen entry age funding method).

Stone Consulting, Inc. prepares an actuarial valuation of the MPAERS annually. This satisfies the requirements under Chapter 32 of the Massachusetts General Laws.

Prepared and included in the actuarial valuation report for use in the Actuarial Section of the Comprehensive Annual Financial Report (CAFR) is the following:

- Schedule of Active Member Valuation Data;
- Schedule of Retirees and Beneficiaries Added to and Removed from Rolls;
- Solvency Test; and
- Schedules of Funding Progress.

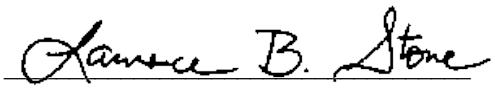
Additionally, for use in the Statistical and Financial sections for the CAFR, we have included and prepared the following:

- Distribution of Plan Members;
- Schedule of Average Benefit Payments;
- Schedule of Benefit Recipients by Type and Option; and
- Schedule of Contributions.

We are pleased to present the results of this valuation. If the MPAERS Board has any questions on the content of this report, we would be glad to respond. Please note that this report is meant to be used in its entirety. Use of excerpts of this report may result in a misleading or inaccurate understanding of the results.

The undersigned is a consultant for Stone Consulting, Inc. and a member of the American Academy of Actuaries and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,
STONE CONSULTING, INC.
Actuaries for the Plan



Lawrence B. Stone
Member, American Academy of Actuaries

SECTION I : RESULTS SUMMARY

Management Summary

Funding		
▪ Contribution for Fiscal 2021	$14,641,803	
▪ Contribution for Fiscal 2020	$12,029,098	
Assets		
▪ Market Value at January 1, 2020	$716,200,538	
▪ Market Value at January 1, 2019	$607,676,792	
▪ Growth in Market Value		17.9%
▪ Actuarial Value at January 1, 2020 (15% corridor)	$681,448,719	
▪ Actuarial Value at January 1, 2019 (15% corridor)	$645,818,828	
▪ Growth in Actuarial Asset Value		5.5%
Members		
▪ Actives	1,348	3.4%
▪ Retired, Disabled and Beneficiaries	872	1.6%
▪ Terminated Vested	74	8.8%
▪ Inactives	169	15.8%
Payroll of Active Members		
▪ Total	$123,193,742	8.0%
▪ Average	$91,390	4.5%
Present Value of Future Benefits		
▪ Actives	$522,003,545	11.3%
▪ Retirees, Terminated Vested, Inactives, 3(8)(c)	403,119,129	5.5%
▪ Total	$852,945,162	8.5%
Funding Ratio Using Entry Age Normal Actuarial Cost Method and Frozen Entry Age		
▪ Entry Age Normal Actuarial Accrued Liability	$755,359,955	
▪ Frozen Entry Age Actuarial Accrued Liability	$727,919,961	
▪ Market Value of Assets	$716,200,538	
▪ Entry Age Funded Ratio using Market Value as of January 1, 2020	94.8%	
▪ Entry Age Funded Ratio using Market Value as of January 1, 2019	86.7%	
▪ Entry Age Funded Ratio using Actuarial Value as of January 1, 2020	90.2%	
▪ Entry Age Funded Ratio using Actuarial Value as of January 1, 2019	92.2%	
▪ Frozen Entry Age Funded Ratio using Actuarial Value under as of January 1, 2020	93.6%	

Percentages in brackets reflect change since the January 1, 2019 Valuation.
Note: Amounts shown in this report may not total due to rounding

Funding Schedule

The funding schedule is based on the Frozen Entry Age Actuarial Cost Method, consistent with the requirements of Section 2 of Chapter 487 of the Acts of 1978. The funding schedule is composed of the normal cost, the amortization of the initial unfunded liability, and the amortization of the liability associated with plan changes such as early retirement incentives, actuarial assumption changes, and asset valuation method changes.

The change in the discount rate from 7.25% to 7.00% contributed to the increase in the contribution compared to Fiscal 2020. This was partially offset by lowering the salary increase assumption from 4.50% to 4.25% and the recognition of compensation limits under Section 401(a)(17) and Section 23 of Chapter 131 of the Acts of 2010. There was an asset gain on the market value of assets in 2019 but there was a small loss on the actuarial value for assets. Valuing assets using an asset smoothing method delays complete recognition of gains and losses. The market value of assets investment return was 19.64%, and, the actuarial value investment return was 6.72%. There were over $38 million in unrecognized actuarial asset losses as of the prior valuation and $13.2 million of that was recognized this year along with $14.9 million of the recognized portion of this year's gain of $74.7 million. The details of the asset-smoothing method are shown later in the report.

The breakdown of the funding schedule appropriation is as follows:

Net Employer Normal Cost including interest	$ 10,266,807
Amortization including interest	4,374,996
Sum of Net Normal Cost and Amortization	$14,641,803
Employer Contribution (Not less than zero)	$14,641,803

The details of the calculation of the normal cost and the amortization are shown in later sections of the report.

Valuation Assumptions and Methodology

The main economic actuarial assumptions used in this valuation have changed from those used in the January 1, 2019 valuation. Changes were made to the interest rate and salary scale assumptions. In addition, the salary maximum under section 401(a)(17) was recognized.

- Interest Rate: The interest rate assumption is 7.00% (7.25% prior year). The interest rate is used to project earnings on assets and to discount the value of future liabilities to the present day. The investment return assumption is a long term assumption and is based on capital market expectations by asset class, historical returns, and professional judgment. We considered analysis prepared by Wilshire, MPAERS's investment advisor, using a building block approach which included expected returns by asset class, risk analysis, and the determination of a 30-year expected target rate of return.
- Salary Assumption: The salary increase assumption is 4.25% (4.50% prior year). It reflects prior experience, current expectations and professional judgement.
- Pension Adjustment Base and Pension Adjustment: We have assumed that the Board would annually grant a 3% pension adjustment to retirees for the first $14,000 of benefits.
- Asset-Smoothing Methodology: The Massport Retirement Board uses an asset-smoothing methodology as part of the actuarial valuation. This methodology has been used to lower the potential volatility of retirement contributions by smoothing investment gains and losses. We have recognized asset gains and losses in excess of the interest rate assumption over a period of 5 years. The result of this smoothing is called the actuarial value of assets and is used in calculating the valuation results. The actuarial value of assets must be between 85% and 115% of the market value of assets. This ensures that the actuarial value of assets is valued within reasonable bounds of market value. The above range is referred to as a 15% corridor.
- Mortality Table: The mortality table is the RP 2014 at 2006 Table (Sex-Distinct) projected with MP2018 Generational Mortality.
- Vacation Buyback Effect: We reflected the recent Contributory Retirement Appeal Board decision and the related PERAC memo that vacation buybacks may not be treated as regular compensation in the calculation of retirement benefits.
- Calculation of 3(8)(c) Liability: The calculation assumes no COLA increases on 3(8)(c) payments.
- Other Assumptions: Withdrawal, disability and retirement rates are the same as the prior valuation.
- Contribution Timing: Contributions into the plan are assumed to be made as of July 1.

The main actuarial assumptions used in the valuation are summarized below. The change in the interest rate and salary increase assumption increased the present value of benefits by $21.7 million and increased the contribution by over $2 million. The recognition of the salary maximum under section 401(a)(17) and Section 23 of Chapter 131 of the Acts of 2010 decreased the present value of future benefits by about $2.2 million and decreased the contribution by $.2 million.

Assumption	January 1, 2020 Valuation
Interest Rate	7.00%
Salary Increase	4.25%
Pension Adjustment Base	$14,000
Pension Adjustment	3.00% on the lesser of the Retirement Allowance and the Pension Adjustment Base
Retirement	
Hired prior to April 2, 2012	
Group 1	Age 50-70 and 10 years of service
Group 2	Age 50-65 and 10 years of service
Group 4	Age 50-65 and 10 years of service
Hired after April 1, 2012	
Group 1	Age 60-70 and 10 years of service
Group 2	Age 55-65 and 10 years of service
Group 4	Age 55-65
Administrative Expense	Estimated budgeted amount: $1,493,000

Assets

We were furnished with a copy of a draft of the System's annual financial report by the Board's administrative staff. The draft financial report was not audited by Stone Consulting, Inc. or the System's auditors. The market value of assets was $716,200,538 as of December 31, 2019. Assets were invested 55% in equities and pooled domestic and international equity funds, 31% in fixed income, cash, payables, receivables and interest accrued, 7% in real estate funds, with the remaining 7% in alternative investments.

The following is a breakdown of the market value of assets by category:

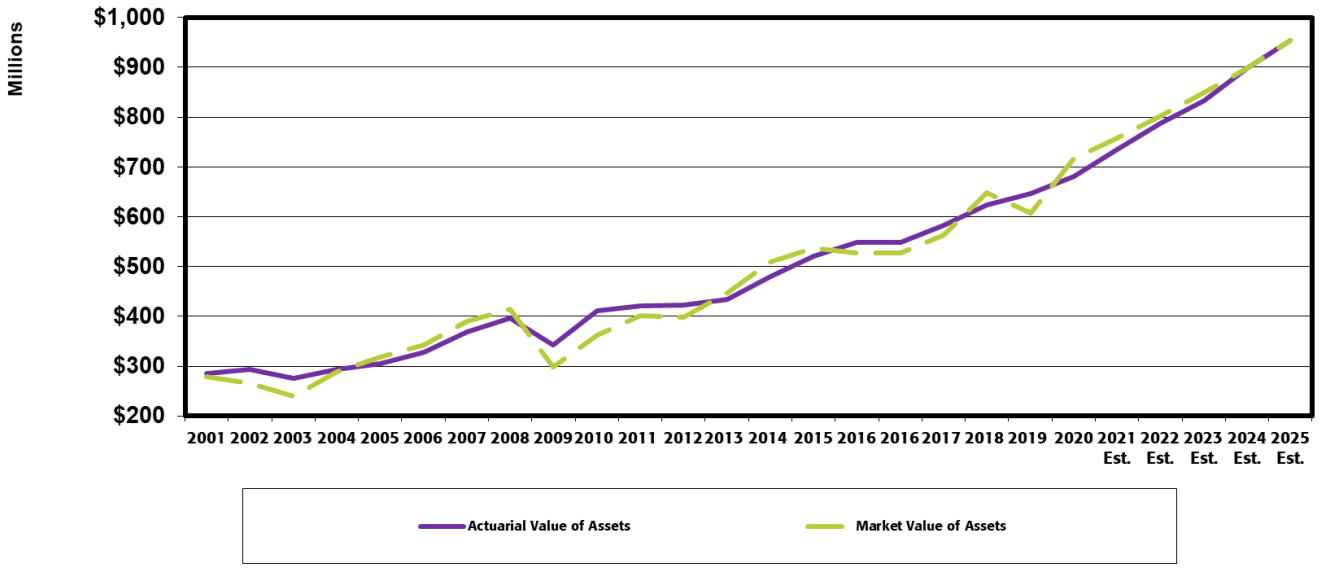
a.	Cash	$	1,198,283.00
b.	Equities		19,899,875.00
c.	Pooled Domestic Equities Funds		171,812,798.00
d.	Pooled International Equities Funds		204,197,155.00
e.	Pooled Domestic Fixed Income Funds		217,630,503.00
f.	Pooled Alternative Investments Funds		47,630,882.00
g.	Pooled Real Estate Funds		52,556,104.00
h.	Subtotal	$	714,925,600.00
i.	Interest Due and Accrued	$	34,138.00
j.	Accounts Receivable		2,280,182.00
k.	Accounts Payable		(1,039,382.00)
l.	Subtotal	$	1,274,938.00
m.	Market Value of Assets [(h) + (l)]	$	716,200,538.00

The actuarial value of assets as of December 31, 2019 is $681,448,719. The actuarial value of assets reflects the use of an asset-smoothing technique. The difference between the actual return and the expected investment return is phased in equally over five years. Applying asset-smoothing is intended to minimize the effect of short-term fluctuations in the market value of assets. To ensure that the actuarial value of assets is not too dissimilar from the market value of assets, we employ a 15% corridor. The actuarial value of assets must be within 15% of the market value of assets. The corridor did not affect the actuarial value of assets this year. The rate of return on the actuarial value of assets was 6.72% during 2019.

The actuarial value of assets is $34.8 million less than the market value of assets. Under the current method, this difference will be recognized over the next 4 years. Based on the investments returning 7.00% in calendar 2020, we anticipate that next year's actuarial value of assets will be $24.1 million lower than market value. If the market value of assets method was used the contribution would be $10.9 million for Fiscal 2021, a decrease of $3.7 million compared to the contribution using the smoothed value of assets.

The chart below shows the effect of the asset smoothing. We have compared the actuarial value of assets to the market value of assets from 2001 to the present with estimated values for 2021 through 2025. As the chart illustrates, the asset smoothing method has been successful in lowering the volatility of the assets used for the actuarial valuation.

The calculation of the actuarial value of assets is shown in the Summary of Valuation Results in Section II of the report.



Analysis of Valuation Results

The Frozen Entry Age Actuarial Cost Method does not explicitly recognize actuarial gains or losses. Actuarial gains or losses are spread over the future working lifetime of active members as part of the normal cost. Therefore, an actuarial loss would increase the normal cost while an actuarial gain would lower the normal cost. For informational purposes, we have calculated an actuarial loss for 2019 of $1.7 million as shown on page 20. The major component of the actuarial loss was an actuarial asset loss of $3.8 million offset in part by liability gains. The asset gain/loss is calculated by comparing the actual values to the expected results based on the January 1, 2019 values and projecting those values respectively by the prior valuation's assumption of a 7.25% asset return. The chart on the following page for illustrative purposes shows the sources of gain/loss under Entry Age Normal as opposed to Frozen Entry Age:

Source	Gain/(Loss) 2019	Gain/(Loss) 2018	Gain/(Loss) 2017	Gain/(Loss) 2016	Gain/(Loss) 2015
Actives					
Withdrawal	$3.6M	$3.9M	$5.4M	$3.9M	$3.6M
Mortality	$0.6M	$0.5M	$0.5M	$0.3M	$0.3M
Disability	$1.0M	$1.0M	$1.0M	$0.7M	$0.9M
Retirement	$(0.04)M	$(1.8)M	$(1.5)M	$(1.3)M	$(0.8)M
Salary Scale	$(3.3)M	$0.5M	$(1.5)M	$8.2M	$(2.3)M
Retired					
Mortality	$4.4M	$0.6M	$(1.3)M	$(1.9)M	$(0.3)M

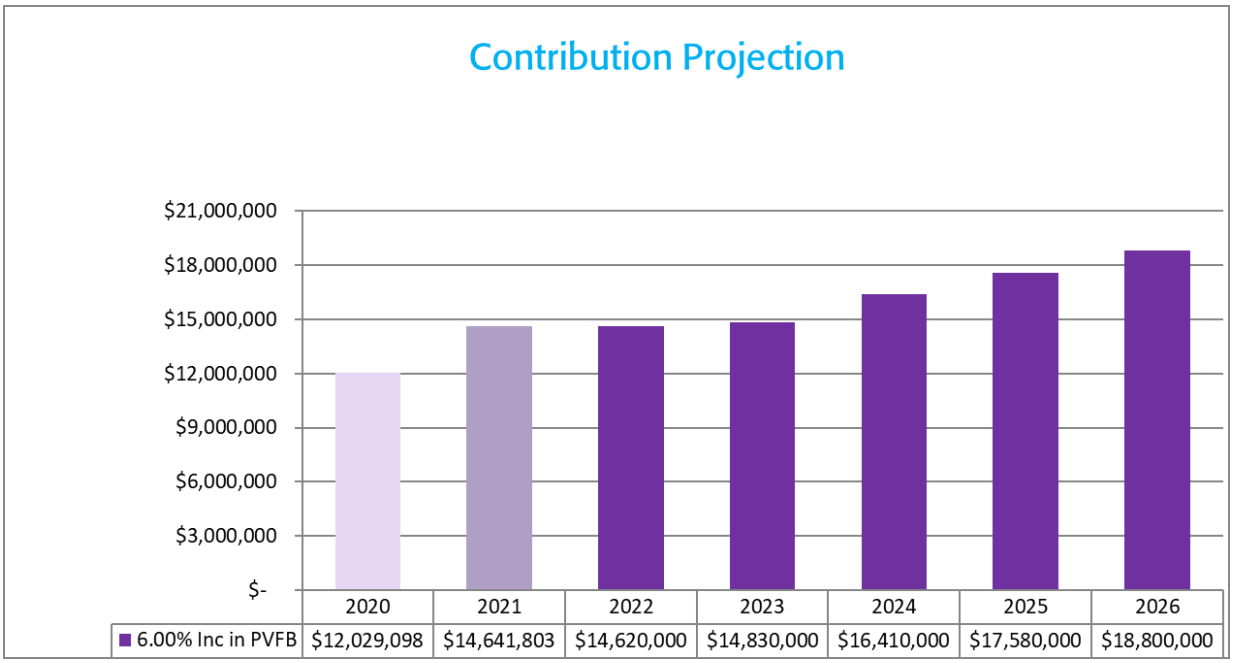
The normal cost development for 2020 is shown on page 17. A comparison of normal costs from 2017 to 2020 is shown on page 18. The present value of future normal costs has increased by $21.5 million from 2019. This increase is primarily due to changes in assumptions. The gross normal cost rate increased from 15.59% of pay in 2019 to 16.07% of pay in 2020. The net normal cost is adjusted with interest from January 1 to July 1. Anticipated administrative expenses of the System are added to the adjusted net normal cost. The administrative expenses exclude custodial and investment manager expenses as these are reflected in the interest assumption that is net of these fees. Administrative fees increased from $1,454,000 to $1,493,000.

The employer retirement contribution is composed of two parts: the adjusted net normal cost with administrative expenses and an amortization of any changes in the liability (measured using the entry age actuarial funding method) due to changes in assumptions or methodologies or benefit provisions. These changes are amortized over 20 years to be consistent with the Massachusetts Port Authority Employees' Retirement System's enabling legislation.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of natural operation of the methodology used for these measurements such as additional contribution requirements based on the plan's funded status; and changes in plan provisions or applicable law. We have calculated projections assuming the present value of future benefits increases each year by 6%. This estimates that the contribution level for 2022 will decrease by $22 thousand compared to 2021,

then increase by $210 thousand in 2023, increase by $1.6 million in 2024, increase by $1.2 million in 2025, and increase by $1.2 million in 2026. The expected increases are mitigated due to the recognition of deferred asset gains from prior years.

The chart below illustrates the contribution projection discussed above.

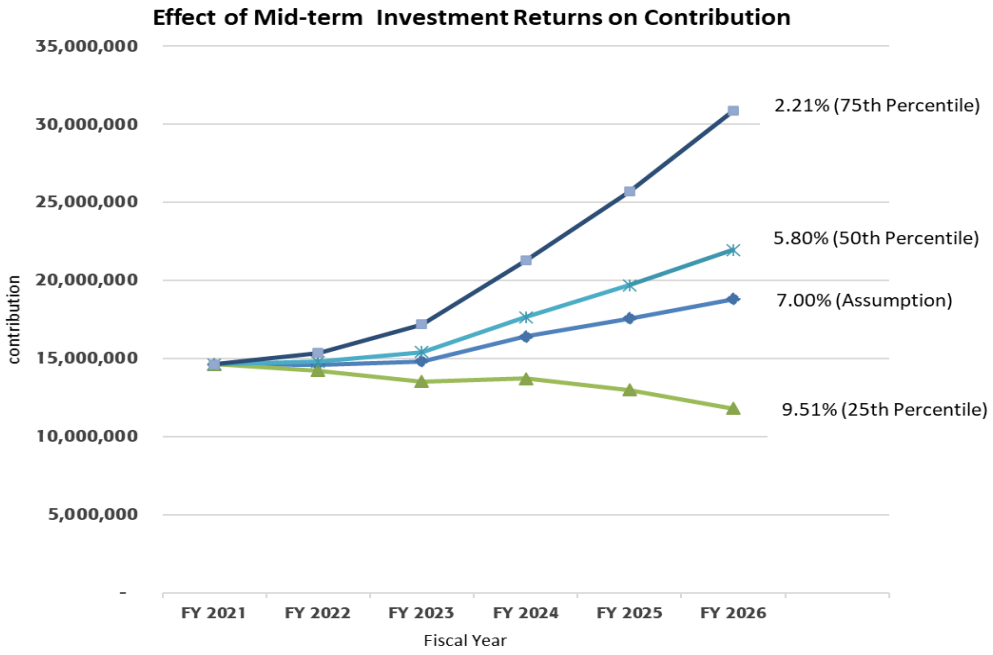


The Frozen Entry Age Actuarial Cost Method has been used in this valuation as required under the enabling legislation. This funding method does not separately value past service liabilities so we are unable to show how well funded the plan is in comparison to liabilities in a meaningful way. A common measure used to illustrate plan funding is the funding ratio. The funding ratio compares the actuarial value of assets to the actuarial accrued liability. We have calculated a funding ratio of 90.2% using the Entry Age Normal Actuarial Cost Method (EAN). If the market value of assets was used the funding ratio would be 94.8%. The EAN method is used by almost all Chapter 32 Retirement Systems and has been shown for illustration purposes only. This shows that the plan is relatively well-funded compared to other Massachusetts public sector retirement systems.

Risk

The effect of different future investment returns can result in widely varying levels of funding as well as on contribution requirements.

The following chart projects the contribution requirement based on 25th to 75th percentile expected investment earnings over the next five years. These returns were provided by the MPAERS's investment adviser, Wilshire. This chart illustrates the volatility of the contribution requirements. Note that 50% of possible scenarios lie outside of the 25th-75th percentile range. So the potential for even more extreme results is a distinct possibility.



Contribution projection based on investment return for Calendar 2020 through 2024 years (Wilshire 5 year return distribution). Due to asset smoothing there is significant unrecognized gains and losses after the years shown ranging from a $81 million gain to a $47 million loss.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as:

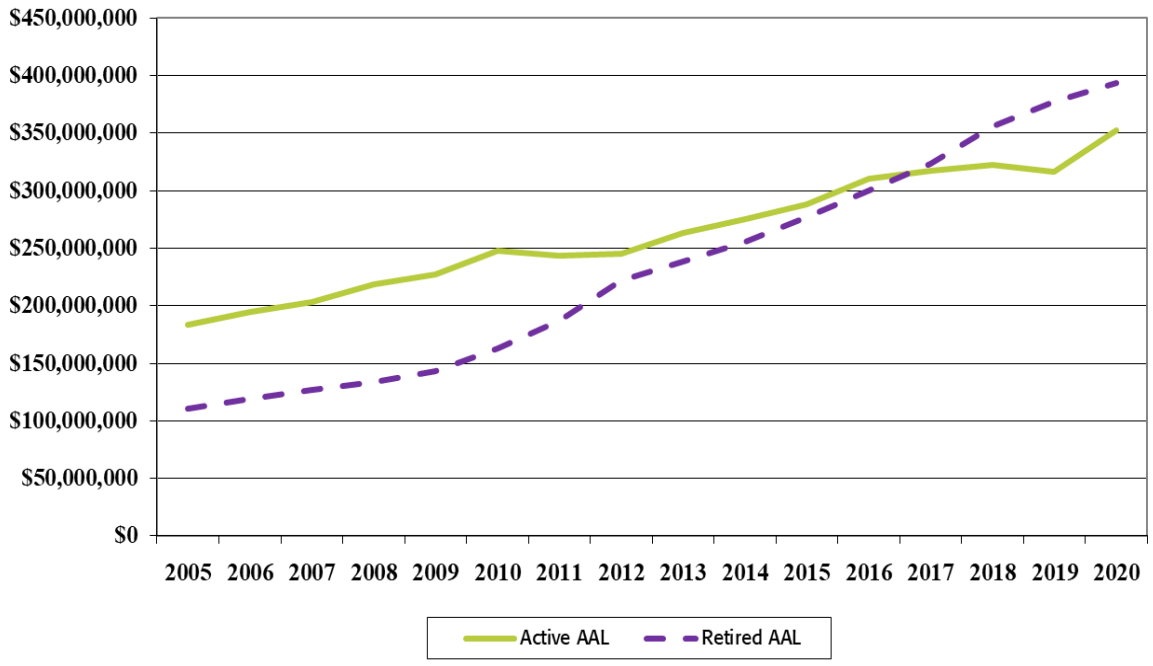
- Plan experience differing from that anticipated by the economic or demographic assumptions,
- Changes in economic or demographic assumptions,
- Increases or decreases expected as part of natural operation of the methodology used for these measurements such as additional contribution requirements based on the plan's funded status,
- Changes in plan provisions or applicable law.

As part of the valuation, we have not performed an analysis of the potential range of future measurements. GASB Statement 67 and 68 reports for the Massachusetts Port Authority Employees Retirement System (MPAERS) contain alternate results to measure the impact of increases or decreases in the discount rate.

Maturity

One important concern is the maturity of the system. Systems with a greater portion of their liability stemming from current retirees whose benefits are already being paid are likely to experience greater impact from short-term asset experience, as high payouts in the near future means less of the current assets will be available to benefit from investment returns further in the future.

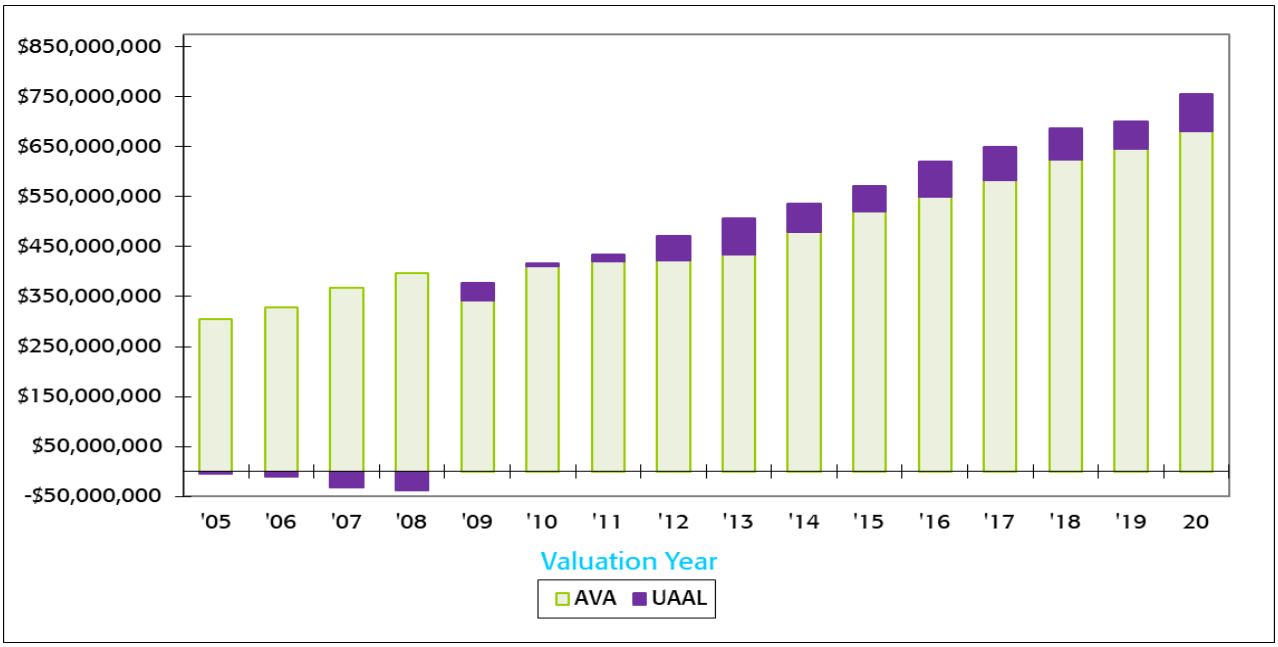
Below is a history of the retiree's percentage of the covered population, and liability. The retiree share of the accrued liability for MPAERS has grown steadily and significantly since 2005.



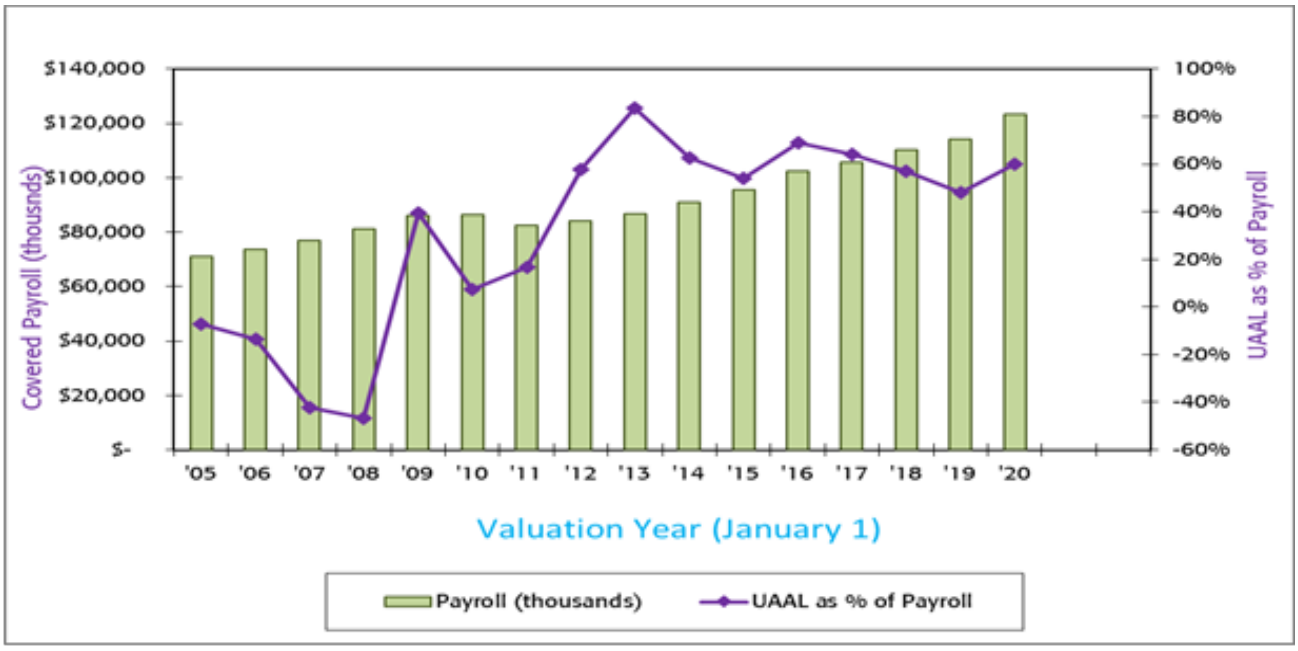
Historical Experience

The following chart displays MPAERS's history of Actuarial Assets and Unfunded Entry Age Actuarial Accrued Liability (UAAL); the second chart compares the UAAL to payroll.

History of Assets and Unfunded Actuarial Accrued Liability



History of Unfunded Actuarial Accrued Liability and Payroll



SECTION II : ACTUARIAL VALUATION RESULTS

Summary of Valuation Results

MEMBER DATA	January 1, 2019	January 1, 2020
1. Active Members		
a. Number	1,304	1,348
b. Annual Compensation	$ 114,017,778	$ 123,193,742
c. Average Annual Compensation	87,437	91,390
d. Average Attained Age	47.0	47.1
e. Average Past Service	12.8	13.0
2. Retired Members and Beneficiaries		
a. Number	858	872
b. Total Annual Retirement Allowance including COLA	$ 34,856,114	$ 35,998,539
c. Average Annual Retirement Allowance including COLA	$ 40,625	$ 41,283
d. Average Age	69.8	70.4
3. Terminated Vested Members		
a. Number	68	74
b. Deferred Benefit Amount	$ 2,290,423	$ 2,373,781
4. Inactives		
a. Number	146	169
b. Annuity Savings Fund Balance	$ 2,769,570	$ 3,466,134
ACTUARIAL COMPONENTS		
1. Present Value of Future Benefits		
a. Active Members	$ 468,936,489	$ 522,003,545
b. Inactive Members	2,769,570	3,466,134
c. Retired Members, Terminated Vesteds, and Beneficiaries	390,337,817	407,860,381
d. 3(8)(c)	(9,098,714)	(8,207,386)
e. Total	$ 852,945,162	$ 925,122,674
2. Actuarial Value of Assets		
a. Market Value as of December 31	$607,676,792	$ 716,200,538
b. Calendar year prior to valuation date Excess Return	(77,737,852)	74,677,060
c. Past Year - 1 Excess Return	51,769,367	(77,737,852)
d. Past Year - 2 Excess Return	4,725,679	51,769,367
e. Past Year - 3 Excess Return	(44,518,230)	4,725,679
f. Actuarial Value of Assets (a)-(.8)(b)-(.6)(c)-(.4)(d)-(.2)(e) (w/o corridor)	$ 645,818,828	$ 681,448,719
g. Actuarial Value of Assets within 15% corridor of Market Value	$ 645,818,828	$ 681,448,719

Note: Amounts shown in this exhibit may not total due to rounding

Summary of Valuation Results (Continued)

		January 1, 2019	January 1, 2020
3.	Frozen Entry Age Actuarial Liability		
a.	Previous Valuation Frozen Liability		
	(i) 2003 Valuation Assumption Change	(5,790,647)	(4,788,718)
	(ii) Base due to 2003 Valuation Assumption Changes/ERI 2003	1,917,157	1,650,831
	(iii) Assumption Change 2004 Valuation	(651,825)	(561,276)
	(iv) Assumption Change 2006 Valuation for 3(8)(c)	(223,663)	(202,059)
	(v) Assumption Change 2008 Valuation	(2,710,006)	(2,516,167)
	(vi) Method Change 2008 Valuation	3,245,552	3,013,406
	(vii) Assumption Change 2009 Valuation	(4,170,401)	(3,909,657)
	(viii) Assumption Change 2010 Valuation	9,100,670	8,599,363
	(ix) Assumption Change 2011 Valuation	611,906	582,014
	(x) Assumption Change 2012 Valuation	12,214,204	11,682,089
	(xi) Assumption Change 2013 Valuation	9,555,577	9,182,579
	(xii) Assumption Change 2015 Valuation	7,267,185	7,036,773
	(xiii) Assumption Change 2016 Valuation	14,749,166	14,325,665
	(xiv) Benefit Change 2018 Valuation	2,898,701	2,829,901
	(xv) Assumption and Benefit change 2019 Valuation	(15,495,982)	(15,495,982)
	(xv) Total	$32,517,594	$31,428,762
b.	Normal Cost for Prior Year	8,375,361	8,788,706
c.	Employer Contribution (Adjusted to January 1)	(12,636,262)	(11,659,161)
d.	Interest	3,172,069	2,070,477
e.	January 1 Frozen Liability prior to additional bases	$31,428,762	$30,628,784
f.	Assumption change 2020 valuation		$15,842,458
g.	Total		$46,471,242

Summary of Valuation Results (Continued)

		January 1, 2019	January 1, 2020
4.	Amortization of Bases as of January 1, 2020		
a.	Assumption Change: $(3,714,149) and 3 years remaining	$(1,325,642)	$(1,322,694)
b.	ERI 2003: $1,365,196 and 4 years remaining	377,921	376,677
c.	Assum. Chg 2004 Valuation: $(464,162) and 4 years remaining	(128,491)	(128,069)
d.	Assum. Chg 2006 Valuation: $(178,889) and 6 years remaining	(35,263)	(35,075)
e.	Assum. Chg 2008 Valuation: $(2,308,274) and 8 years remaining	(363,930)	(361,272)
f.	Method Chg 2008 Valuation: $2,764,430 and 8 years remaining	435,849	432,666
g.	Assum. Chg 2009 Valuation: $(3,630,009) and 9 years remaining	(525,033)	(520,708)
h.	Assum. Chg 2010 Valuation: $8,061,711 and 10 years remaining	1,082,616	1,072,716
i.	Assum. Chg 2011 Valuation: $549,954 and 11 years remaining	69,236	68,542
j.	Assum., Ben Chg 2012 Val: $11,111,396 and 12 years remaining	1,321,813	1,307,427
k.	Assum. Chg 2013 Val: $8,782,538 and 13 years remaining	993,732	982,092
l.	Assum. Chg 2015 Val: $6,789,656 and 15 years remaining	706,091	696,699
m.	Assum. Chg 2016 Val: $13,871,460 and 16 years remaining	1,391,903	1,372,337
n.	Benefit Chg. 2018 Val: $2,756,113 and 18 years remaining	260,099	256,068
o.	Assum., Ben Chg 2019 Val: $(15,128,187) and 19 years remaining	(1,390,446)	(1,367,942)
p.	Assum. Chg. 2020 Val: $15,842,458 and 20 years remaining	-	1,397,585
q.	Total	$2,870,455	$4,227,049
5.	Contribution		
a.	Net Normal Cost (Including Admin Expense, Without Interest)	$8,788,706	$9,970,108
b.	Amortization	2,870,455	4,227,049
c.	Interest Adjustment for 1/1 to 7/1	369,937	444,646
d.	Total (Not less than zero)	$12,029,098	$14,641,803

Note: Amounts shown in this exhibit may not total due to rounding

Development of Normal Cost

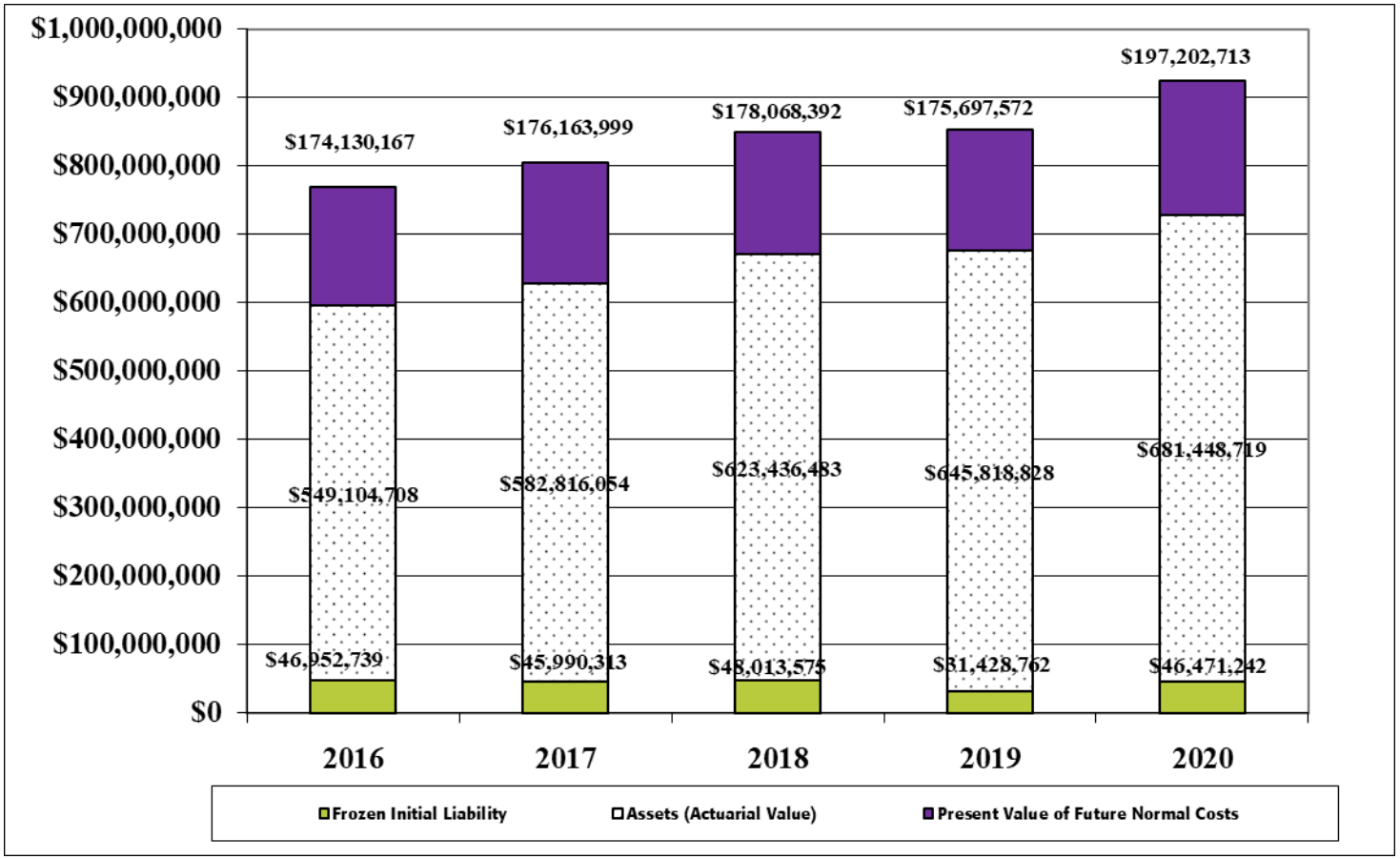
	January 1, 2020
1. Present Value of Future Benefits	$925,122,674
2. Frozen Initial Liability	$46,471,242
3. Assets (Actuarial Value)	$681,448,719
4. Present Value of Future Normal Costs (1 -2 -3)	$197,202,713
5. Present Value of Future Salaries	$1,226,786,245
6. Normal Cost Percentage (4 / 5)	16.0747%
7. Pay (excluding Employees at Retirement Age)	$127,491,002
8. Gross Normal Cost (6 x 7)	$20,493,849
9. Anticipated Employee Contributions	$12,016,741
10. Net Normal Cost (8 – 9)	$8,477,108
11. Interest Adjustment (1/1 to 7/1)	$296,699
12. Interest Adjustment for Contribution Timing	0
13. Administrative Expense Assumption	$1,493,000
14. Normal Cost (With Adjustments) (10 + 11 + 12 + 13)	$10,266,807

Note: Amounts shown in this exhibit may not total due to rounding

Comparison of 2017, 2018, 2019 and 2020 Normal Cost

	1/1/2017	1/1/2018	1/1/2019	1/1/2020
Present Value of Future Benefits	$804,970,366	$849,518,450	$852,945,162	$925,122,674
Frozen Initial Liability	$45,990,313	$48,013,575	$31,428,762	$46,471,242
Assets (Actuarial Value) [Uses a 15% corridor]	$582,816,054	$623,436,483	$645,818,828	$681,448,719
Present Value of Future Normal Costs	$176,163,999	$178,068,392	$175,697,572	$197,202,713
Present Value of Future Salaries	$1,090,314,620	$1,149,130,446	$1,126,928,668	$1,226,786,245
Normal Cost Percentage	16.16%	15.50%	15.59%	16.07%
Pay (excluding Employees at Retirement age)	$110,173,417	$114,541,433	$118,474,562	$127,491,002
Gross Normal Cost	$17,800,908	$17,749,255	$18,471,172	$20,493,849
Anticipated Employee Contributions	$10,310,981	10,787,894	11,136,466	12,016,741
Net Normal Cost	$7,489,927	$6,961,361	$7,334,706	$8,477,108
Interest Adjustment (1/1 to 7/1)	$271,510	$252,349	$265,883	$296,699
Interest Adjustment for Contribution Timing	$0	$0	$0	$0
Administrative Expense Assumption	$1,455,000	$1,414,000	$1,454,000	$1,493,000
Normal Cost (With Adjustments)	$9,216,437	$8,627,710	$9,054,589	$10,266,807

Breakdown of Present Value of Future Benefits



Derivation of Experience Gain or (Loss)

1.	Normal Cost Rate Last Year	15.59%
2.	Normal Cost Rate This Year	16.07%
3.	Increase (Decrease) in Normal Cost Rate (2-1)	0.48%
4.	Actuarial Present Value of Future Salaries	$1,226,786,245
5.	Increase (Decrease) in Actuarial Present Value of Future Normal Cost (3 x 4)	$5,888,574
6.	Increase (Decrease) due to Change in Assumptions, Benefits and Methods	$4,171,073
7.	Net Actuarial Gain/(Loss) [6-5]	$(1,717,501)

Calculation of Valuation Assets as of January 1, 2020

5-YEAR PHASE-IN OF ASSET GAINS AND LOSSES

1. Market value of assets including receivable/payable as of January 1, 2020 — $716,200,538
2. Phase-in of asset gains and losses

	Plan Year (1)	Original Amt (2)	Pct Unrecognized (3)	Amt Unrecognized (2) x (3)
a.	2019	$74,677,060*	80%	$59,741,648
b.	2018	(77,737,852)	60%	(46,642,711)
c.	2017	51,769,367	40%	20,707,747
d.	2016	4,725,679)	20%	945,136
e.	2015	(44,518,230)	0%	0
f.	Total			$34,751,819

3. Valuation assets without corridor as of January 1, 2020: (1. - 2.f.) — $681,448,719
4. Corridor Check
   a. 85% of Market Value — $608,770,457
   b. 115% of Market Value — $823,630,619
5. Greater of 3. And 4.a. — $681,448,719
6. Valuation assets with corridor as of January 1, 2020: Lesser of 5. And 4.b. — $681,448,719
7. Calculation of return on valuation assets
   a. Valuation assets as of January 1, 2019 — $645,818,828
   b. ER contribs + EE contribs - Ben Pymts - Expenses — (9,852,720)
   c. Actual return on valuation assets 6. - (7.a. + 7.b.) — $45,482,611
   d. Weighted value of valuation assets — $676,522,359
   e. Return on valuation assets: 7.c. / 7.d. — 6.72%

*Equal to current year market value of $716,200,538 minus: the prior year market value of $607,676,792 plus Employer and Employee contributions of $24,605,427 less benefit payments and expenses of $34,458,147 plus expected investment earnings of $43,699,406.

Analysis of Financial Experience

The Frozen Entry Age Actuarial Cost Method does not explicitly recognize actuarial gains or losses. Actuarial gains and losses are spread over the future working lifetime of the active members as part of the normal cost. Therefore, an actuarial loss would increase the normal cost as a percentage of payroll while an actuarial gain would lower the normal cost as a percentage of payroll.

Gross Normal Cost as a Percentage of Payroll
(prior to Employee Contributions and Expenses)

	1/1/2019	1/1/2020
Prior Year's Gross Normal Cost (1/1/2018, 1/1/2019)	15.50%	15.59%
Increases/(Decreases) due to:		
▪ Liability experience	(.77)	(.15)
▪ Investment experience	1.19*	.29*
▪ Changes in benefits, assumptions and methods	(.33)	.34
Total	.09	.48
Current Valuation	15.59%	16.07%

*Includes prior years' investment experience which was recognized this year.

Disclosures

- Stone Consulting, Inc. was furnished member data by the administration staff of the MPAERS. Although examined under broad parameters for reasonableness, the data was not audited by the actuary. In addition, the administrative staff furnished financial statements that were not audited by the actuary or by the plan's auditors. With the assistance of the staff of MPAERS, we were able to develop a database sufficient for valuation purposes.

- The investment return assumption is a long-term assumption and is based on capital market expectations by asset class, historical returns, and professional judgement.

- Historically, 10% to 11% has been the expected long-term rate of return for equities, and 6% to 7% has been the expected long-term rate of return for fixed income securities. Many economists and investment professionals are projecting lower returns of 7% to 8% for equities and 4% to 6% for fixed income securities. In light of these projections, as well as historical investment returns, the 7.25% interest rate assumption is within the reasonable assumption range. We encourage close monitoring for changes in investment performance against expectations.

- The salary increase assumption reflects prior experience, current expectations, and professional judgement.

- The UAAL and funded ratio are measures of the plan's funded status. These measures reflect the plan's position as of January 1, 2020. We believe these measures, by themselves, are not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations or assessing the need for or the amount of future contributions. However, we believe these measures, in conjunction with the plan's funding schedule, are appropriate for assessing the amount of future contributions.

Disclosure Information

This disclosure information is based on GASB Statement 25 prior to the issuance of GASB Statement 67. The Retirement Board has requested this be included in the valuation report. Information with regards to GASB Statements 67 and 68 can be found in a separate report issued by Stone Consulting, Inc. as well as the MPAERS's Financial report and the Massachusetts Port Authority's Financial Statement.

The most recent actuarial valuation of the System was prepared by Stone Consulting, Inc. as of January 1, 2020.

The normal cost for employees on that date was	$12,016,741	9.43% of expected payroll
The normal cost for the employer was	$9,970,108	7.82% of expected payroll

The actuarial accrued liability for active members was*	N/A
The actuarial accrued liability for retired members was*	N/A
Total actuarial accrued liability*	$727,919,961
System assets as of that date	$681,448,719
[Market value of assets]	[$716,200,538]
Unfunded actuarial accrued liability*	$46,471,242

*Frozen entry age. Per Q&A – 88 of the GASB Statement 25 Implementation Guide requires you to illustrate the funding progress using the frozen initial unfunded amounts. The actuarial liability shown is the frozen initial unfunded amount plus the assets. The funding method does not explicitly calculate an actuarial accrued liability and therefore it cannot be broken down by active and retired members.

The ratio of system's valuation assets to total actuarial liability was 93.6%

The principal actuarial assumptions used in the valuation are as follows:

Investment Return:	7.00% per annum
Rate of Salary Increase:	4.25% per annum

Disclosure Information (Continued)

SCHEDULE OF FUNDING PROGRESS

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (AAL) (b)	Unfunded AAL (UAAL) (b-a)	Funded Ratio (a/b)	Covered Payroll (c)	UAAL as a % of Covered Payroll ((b-a)/c)
1/1/2020	$681,448,719	$727,919,961	$46,471,242	93.6%	$123,193,742	37.7%
1/1/2019	$645,818,828	$677,247,590	$31,428,762	95.4%	$114,017,778	27.6%
1/1/2018	$623,436,483	$671,450,058	$48,013,575	92.8%	$110,221,357	43.6%
1/1/2017	$582,816,054	$628,806,367	$45,990,313	92.7%	$105,659,425	43.5%
1/1/2016	$549,104,708	$596,057,447	$46,952,739	92.1%	$102,262,879	45.9%
1/1/2015	$520,740,990	$552,644,012	$31,903,022	94.2%	$95,475,718	33.4%
1/1/2014	$479,181,222	$503,474,105	$24,292,883	95.2%	$90,979,477	26.7%
1/1/2013	$433,408,458	$457,937,151	$24,528,693	94.6%	$86,729,766	28.3%
1/1/2012	$422,998,843	$436,468,016	$13,469,173	96.9%	$84,044,762	16.0%
1/1/2011	$420,800,868	$419,271,699	($1,529,169)	100.4%	$82,540,581	(1.9%)

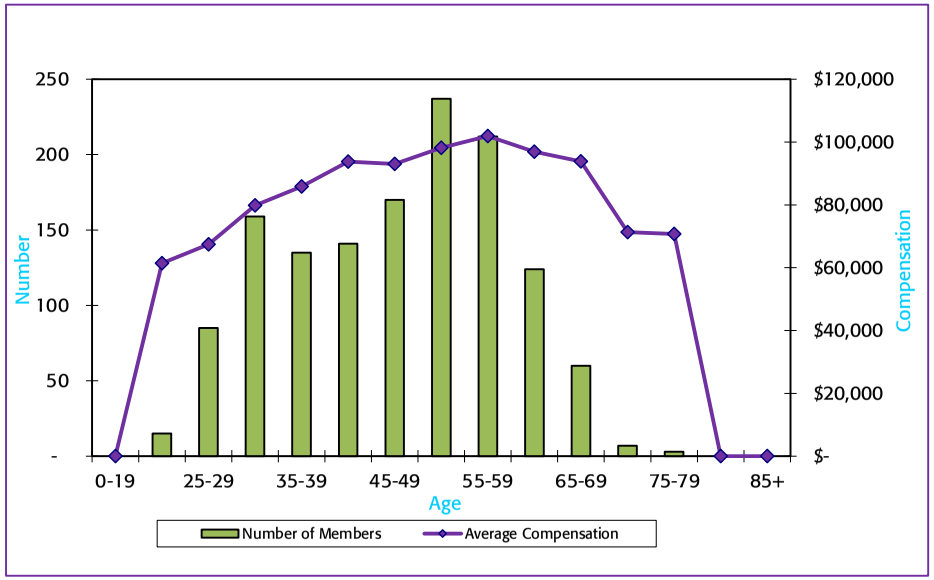
Notes to Schedule

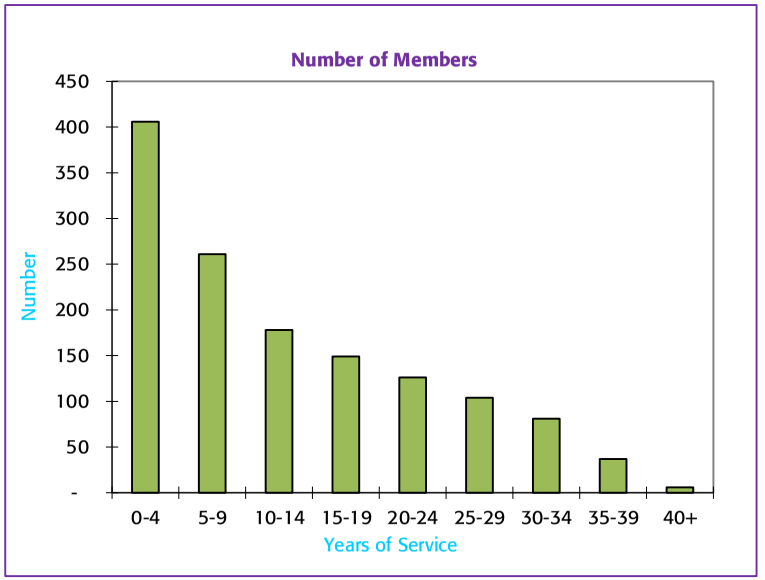
Valuation Date:	1/1/2020
Actuarial Cost Method:	Frozen Entry Age
Amortization Method:	Level. Closed amortization
Remaining Amortization Period:	Multiple bases with remaining periods ranging from 3 years to 20 years.
Asset Valuation Method:	5 year asset smoothing with a 15% corridor
Actuarial Assumptions:	Investment Rate of Return 7.00% per annum
	Projected Salary Increases 4.25% per annum

Distribution of Plan Members as of January 1, 2020

Active Members

AGE	0-4 Years	5-9 Years	10-14 Years	15-19 Years	20-24 Years	25-29 Years	30-34 Years	35-39 Years	40 + Years	Total	Total Compensation	Average Compensation
0-19	-	-	-	-	-	-	-	-	-	-	$ -	$ -
20-24	15	-	-	-	-	-	-	-	-	15	921,434	61,429
25-29	77	8	-	-	-	-	-	-	-	85	5,733,103	67,448
30-34	93	59	7	-	-	-	-	-	-	159	12,694,127	79,837
35-39	56	49	26	4	-	-	-	-	-	135	11,588,117	85,838
40-44	41	31	31	27	9	2	-	-	-	141	13,215,211	93,725
45-49	38	33	26	28	25	19	1	-	-	170	15,808,962	92,994
50-54	42	32	33	38	33	36	21	2	-	237	23,270,821	98,189
55-59	24	24	30	25	28	30	36	14	1	212	21,603,131	101,902
60-64	15	14	15	18	22	9	13	17	1	124	12,016,291	96,906
65-69	4	10	9	8	7	8	7	3	4	60	5,630,976	93,850
70-74	1	1	-	1	-	-	3	1	-	7	499,438	71,348
75-79	-	-	1	-	2	-	-	-	-	3	212,130	70,710
80-84	-	-	-	-	-	-	-	-	-	-	-	-
85+	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	406	261	178	149	126	104	81	37	6	1,348	$ 123,193,742	$ 91,390





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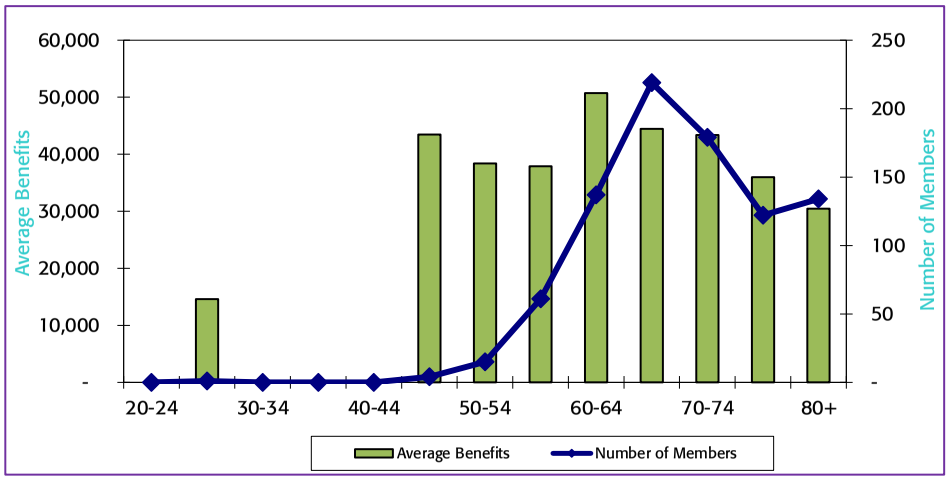
Distribution of Plan Members as of January 1, 2020

Retired Members

Retired Members and Beneficiaries			
Age	Number	Average Benefit	Total Benefit
20-24	-	-	-
25-29	1	14,604	14,604
30-34	-	-	-
35-39	-	-	-
40-44	-	-	-
45-49	3	38,410	115,231
50-54	13	35,487	461,330
55-59	47	34,735	1,632,533
60-64	127	50,871	6,460,674
65-69	209	44,636	9,328,845
70-74	171	43,737	7,478,986
75-79	116	35,526	4,121,045
80+	128	30,061	3,847,799
TOTAL	815	$ 41,057	$ 33,461,047

Disabled Members			
Age	Number	Average Benefit	Total Benefit
20-24	-	-	-
25-29	-	-	-
30-34	-	-	-
35-39	-	-	-
40-44	-	-	-
45-49	1	58,583	58,583
50-54	2	57,191	114,382
55-59	14	48,413	677,783
60-64	10	48,695	486,955
65-69	10	40,875	408,745
70-74	8	35,788	286,302
75-79	6	45,003	270,021
80+	6	39,120	234,721
TOTAL	57	$ 44,517	$ 2,537,492

Total			
Age	Number	Average Benefit	Total Benefit
20-24	-	-	-
25-29	1	14,604	14,604
30-34	-	-	-
35-39	-	-	-
40-44	-	-	-
45-49	4	43,453	173,814
50-54	15	38,381	575,712
55-59	61	37,874	2,310,316
60-64	137	50,713	6,947,629
65-69	219	44,464	9,737,590
70-74	179	43,381	7,765,288
75-79	122	35,992	4,391,066
80+	134	30,467	4,082,521
TOTAL	872	$ 41,283	$ 35,998,539



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Schedule of Active Member Valuation Data

Valuation Date	Number	Annual Payroll	Annual Average Pay	Increase In Average Pay
1/1/2020	1,348	$123,193,742	$91,390	4.5%
1/1/2019	1,304	$114,017,778	$87,437	2.2%
1/1/2018	1,288	$110,221,357	$85,576	2.7%
1/1/2017	1,268	$105,659,425	$83,328	1.4%
1/1/2016	1,245	$102,262,879	$82,139	2.5%
1/1/2015	1,191	$95,475,718	$80,164	2.3%
1/1/2014	1,161	$90,979,477	$78,363	2.1%
1/1/2013	1,130	$86,729,766	$76,752	2.2%
1/1/2012	1,119	$84,044,762	$75,107	-0.9%
1/1/2011	1,089	$82,540,581	$75,795	-0.3%

Schedule of Retirees and Beneficiaries Added to and Removed from Rolls

	Added to Rolls		Removed from Rolls		Rolls: End of Year			
Valuation Date	No.	Annual Allowances	No.	Annual Allowances	No.	Annual Allowances	% Increase in Annual Allowances	Average Annual Allowances
1/1/2020	40	$1,754,095	26	$982,527	872	$35,998,539	3.3%	$41,283
1/1/2019	56	$2,864,801	24	$773,963	858	$34,856,114	7.1%	$40,625
1/1/2018	75	$3,373,043	28	$853,171	826	$32,553,942	9.3%	$39,412
1/1/2017	47	$2,447,748	17	$470,350	779	$29,780,717	8.3%	$38,229
1/1/2016	52	$2,312,489	21	$676,452	749	$27,498,124	7.1%	$36,713
1/1/2015	51	$2,070,732	19	$586,503	718	$25,678,308	7.4%	$35,764
1/1/2014	45	$1,763,845	14	$361,877	686	$23,904,002	7.6%	$34,845
1/1/2013	41	$1,537,663	16	$494,358	655	$22,208,579	5.7%	$33,906
1/1/2012	63	$2,811,187	12	$211,424	630	$21,017,707	15.3%	$33,361
1/1/2011	62	$2,378,822	14	$285,287	579	$18,221,175	14.0%	$31,470

Notes:

Additional changes to annual retirement allowances can be due to various factors including:

1. Cost of living increases under Massachusetts General Laws Chapter 103
2. Retroactive benefit changes
3. Post-retirement COLA under Massachusetts General Laws Chapter 32, Sections 90A, 90C and 90D
4. Suspension of benefits
5. Changes in worker's compensation offsets
6. Data corrections
7. Change in dependents' allowance due to dependents exceeding age limit.

Solvency Test

A solvency test is a method of checking the short-term progress towards funding. The plan's present actuarial value of assets is compared to:

1. Active members' contributions;
2. Liabilities for retirees and beneficiaries; and
3. Liabilities for service accrued for active members and inactive members

	Actuarial Accrued Liability (AAL)				Portion of AAL Covered by Assets		
Valuation Date	Active Member Contributions (1)	Retirees and Beneficiaries (2)	Active/Inactive Members (Employer Financed) (3)	Actuarial Value of Assets	(1)	(2)	(3)
1/1/2020	$117,046,783	$385,176,782	$225,696,396	$681,448,719	100%	100%	79.4%
1/1/2019	$108,465,873	$368,316,861	$200,464,856	$645,818,828	100%	100%	84.3%
1/1/2018	$105,900,611	$348,123,401	$217,426,046	$623,436,483	100%	100%	77.9%
1/1/2017	$104,130,296	$317,558,267	$207,117,804	$582,816,054	100%	100%	77.8%
1/1/2016	$100,448,530	$293,058,960	$202,549,957	$549,104,708	100%	100%	76.8%
1/1/2015	$97,096,332	$270,897,577	$184,650,103	$520,740,990	100%	100%	82.7%
1/1/2014	$94,361,394	$249,709,368	$159,403,343	$479,181,222	100%	100%	84.8%
1/1/2013	$90,907,523	$233,425,040	$133,604,588	$433,408,458	100%	100%	81.6%
1/1/2012	$86,830,067	$217,864,260	$131,773,689	$422,998,843	100%	100%	89.8%
1/1/2011	$85,699,175	$183,305,136	$150,267,388	$420,800,868	100%	100%	100%

Notes:

- Under the Frozen Entry Age cost method actuarial accrued liability is not directly calculated. Actuarial accrued liability, as determined here, is that portion of the present value of future benefits that will not be paid by future employer normal costs.
- January 1, 2009 numbers reflect a change in assumptions. Mortality is based on the RP 2000 Table with projection for 9 years, an interest rate of 8% (from 7.75%) and salary rate of 4.75% (from 5%).
- January 1, 2010 numbers reflect a change in assumptions. Mortality is based on the RP 2000 Table with projection for 10 years, an interest rate of 7.75% (from 8.00%).
- January 1, 2011 numbers reflect a change in assumptions. Mortality is based on the RP 2000 Table with projection for 11 years.

- January 1, 2012 numbers reflect a change in assumptions. Mortality is based on the RP 2000 Table with projection for 22 years (from 11 year projection), an interest rate of 7.625% (from 7.75%) and salary rate of 4.50% (from 4.75%) and a change in the pension increase adjustment base (COLA base) to $13,000 (from $12,000).
- January 1, 2013 numbers reflect a change in assumptions. Mortality is based on the RP 2000 Table (Sex-distinct) projected with Scale BB and Generational Mortality (from 22 year projection) and a change to retirement, disability and withdrawal assumptions.
- January 1, 2015 numbers reflect a change in assumptions. The interest rate was changed to 7.50% (from 7.625%).
- January 1, 2016 numbers reflect a change in assumptions. The interest rate was changed to 7.25% (from 7.50%) and retirement age is delayed until age 60 for post 9/30/2009 hires who are not eligible for post-retirement medical insurance until age 60.
- January 1, 2018 numbers reflect a change in the pension increase adjustment base (COLA Base) to $14,000 (from $13,000)
- January 1, 2019 numbers reflect a change in assumptions. Mortality is based on the RP2014 at 2006 Table Healthy Employees (sex-distinct) projected with MP2018 Generational Mortality and a change to retirement, disability and withdrawal assumptions. Also reflects a change in the treatment of vacation buybacks.
- January 1, 2020 numbers reflect a change in assumptions. The interest rate was changed to 7.00% (from 7.25%). The salary increase assumption was changed to 4.25% (from 4.50%). Compensation limits under Section 401 (a) (17) were recognized.

Actuarial Methods and Assumptions

The assumptions used for the actuarial valuation are recommended by the actuary and adopted by the Retirement Board on an annual basis in conjunction with guidance provided by the actuary. Refer to number 15 of this section to see changes in assumptions and methods.. In addition, Massachusetts State Law specifies the actuarial cost method to be used.

ACTUARIAL METHODS

1. Actuarial Cost Method	The Frozen Entry Age Actuarial Cost Method has been used in this valuation. Under this method, the present value of all future benefits is determined for each individual participant as of each valuation date. The unfunded frozen actuarial liability represents the unfunded portion of the initial actuarial accrued liability as adjusted for plan changes and changes in assumptions. The annual normal cost is then determined as the amount necessary to fund, as a level percentage of pay of the participants included in the valuation, the excess of the present value of future benefits over the sum of the assets and the unfunded actuarial accrued liability. Actuarial gains and losses are not directly recognized under this method, but are spread over future years as a portion of the annual normal cost.
2. Asset Valuation Method	The Asset Valuation Method is the market value of assets (adjusted by payables and receivables) adjusted to phase in investment gains or losses above or below the expected rate of investment return. A five-year rolling period is used. The phase-in is 20% for year one, 40% for year two, 60% for year three, 80% for year four and 100% for year five. The actuarial value of assets must be within a corridor of 85% to 115% of the adjusted market value of assets.

ACTUARIAL ASSUMPTIONS

1. Investment Return Rate	7.00% per year
2. Mortality	▪ Pre-Retirement: RP2014 at 2006 Table Healthy Employees (sex-distinct) projected with MP2018 Generational Mortality. ▪ Post-Retirement: RP2014 at 2006 healthy annuitant Table (sex-distinct) projected with MP2018 Generational Mortality.

Actuarial Methods and Assumptions (Continued)

Mortality (cont'd)

- Disabled: RP2014 at 2006 healthy annuitant Table (sex-distinct) projected with MP2018 Generational Mortality set-forward 2 years was used. Mortality for accidental disability is assumed to be 50% from the same cause as the disability.

3a. Rates of Retirement

Group 1, 2 and 4 employees are assumed to retire at the following rates upon attainment of 10 years of service. If hired after 9/30/2009 and not eligible for post-retirement medical insurance until age 60, retirement begins at, age 60 with 10 years of service.

Rates of Retirement
(Employees Hired pre- April 2, 2012)

Age	Group 1	Group 2*	Group 4
50	2%	2%	2%
51	2	2	2
52	2	2	2
53	3	3	3
54	3	3	5
55	5	5	9
56	5	5	9
57	5	5	11
58	7	7	13
59	7	7	13
60	15	15	20
61	18	18	15
62	18	18	15
63	18	18	20
64	15	15	20
65	30	35	100
66	35	35	N/A
67	35	35	N/A
68	35	35	N/A
69	35	35	N/A
70	100	100	N/A

Actuarial Methods and Assumptions (Continued)

Prior valuation assumption was as follow:

Age	Group 1	Group 2*	Group 4
50	1%	1%	5%
51	1	1	5
52	1	1	5
53	3	3	5
54	3	3	5
55	4	3	35
56	4	3	15
57	5	5	15
58	4	4	15
59	6	6	15
60	13	13	15
61	13	13	15
62	11	11	15
63	12	15	15
64	13	15	15
65	30	100	100
66	30	N/A	N/A
67	30	N/A	N/A
68	30	N/A	N/A
69	30	N/A	N/A
70	100	N/A	N/A

Actuarial Methods and Assumptions (Continued)

3b. Rates of Retirement

Employees Hired after April 1, 2012

Rates of Retirement

Age	Group 1	Group 2*	Group 4
50	-	-	-
51	-	-	-
52	-	-	-
53	-	-	-
54	-	-	-
55	-	10%	3%
56	-	6	3
57	-	5	9
58	-	7	11
59	-	9	13
60	22%	12	20
61	18	15	15
62	18	23	15
63	19	19	20
64	15	16	20
65	15	30	100
66	20	35	N/A
67	35	35	N/A
68	35	35	N/A
69	35	35	N/A
70	100	100	N/A

Actuarial Methods and Assumptions (Continued)

4. Withdrawal Prior to Retirement

The rates shown at the following sample ages illustrate the ultimate withdrawal assumption. There is a 10 year select period for Groups 1 and 2.

Rate of Withdrawal

Age	Groups 1 and 2*	Group 4*
25	7.0%	6.0%
30	7.0	0.5
35	6.0	0.5
40	4.0	0.4
45	3.0	0.1
50	0.5	N/A
55	0.5	N/A

*Groups 1, 2 and 4 are assigned based on employee class, as described in the Summary of Principal Plan Provisions, Section 1.

Actuarial Methods and Assumptions (Continued)

5. Disability Prior to Retirement

The rates shown at the following sample ages illustrate the assumption regarding the incidence of disability:

Rate of Disability

Age	Group 1*	Group 2*	Group 4*
25	.01%	.01%	.40%
30	.01	.01	.40
35	.34	.34	.40
40	.68	.68	.40
45	.10	.10	.50
50	.133	.133	.65
55	.14	.14	.65
60	.12	.12	.20

Disability is assumed to be 25% ordinary and 75% accidental for Groups 1 and 2 and 10% ordinary and 90% accidental for Group 4.

*Groups 1, 2 and 4 are assigned based on employee class, as described in the Summary of Principal Plan Principal Plan Provisions, Section 1

Actuarial Methods and Assumptions (Continued)

6.	Salary Increases	4.25% per year.
7.	Regular Interest Rate Credited to Annuity Savings Account	2% per year.
8.	Family Composition	Members are assumed to be married with two dependent children - one male and one female both age 15; age difference between member and spouse assumed to be three years (the male being the older).
9.	Pension Adjustments	For purposes of the valuation, it is assumed that the Massachusetts Port Authority Employees' Retirement Board will fund 3% annual pension adjustment (cost-of-living increases).
10.	Pension Adjustment Base	The pension adjustment base (cost-of-living base) is assumed to be $14,000.
11.	Expenses	Budgeted amount for the fiscal year, excluding investment management fees and custodial fee, is added to the Normal Cost.
12.	Credited Service	An active member's credited service is attributed to Massachusetts Port Authority employment.
13.	Vacation Buybacks	Vacation Buybacks were assumed to not be regular compensation and were not considered in the calculation of future retirement benefits. A liability of $473,152 was assumed to reflect the value of return of employee contributions that were previously taken on vacation buybacks.
14.	Valuation Date	January 1, 2020.
15.	Inflation Rate Assumption	2.75%

Actuarial Methods and Assumptions (Continued)

16. Recent Changes

As of January 1, 2020 the interest rate changed to 7.00% (from 7.25%) and salary rate to 4.25% (from 4.50%). The salary maximum under section 401(a)(17) was recognized.

As of January 1, 2019 the mortality assumption was changed to the RP2014 at 2006 Table Healthy Employees (sex-distinct) projected with MP2018 Generational Mortality. The withdrawal, retirement and disability assumptions were also changed. Vacation buybacks were assumed not to be regular compensation.

As of January 1, 2018 the benefit adjustment base (COLA base) was increased to $14,000 (from $13,000)

As of January 1, 2016 the interest rate changed to 7.25% (from 7.50%) and employees hired after 9/30/2009 and not eligible for post-retirement medical insurance until age 60, retirement begins at age 60 with 10 years of service.

As of January 1, 2015 the interest rate changed to 7.50% (from 7.625%).

As of January 1, 2013 the mortality assumption was changed to the RP2000 Generational Table and the retirement, disability and withdrawal assumptions were changed based on an experience study.

As of January 1, 2012 the mortality assumption was changed to the RP 2000 Table projected forward 22 years with Scale AA, interest rate changed to 7.625% (from 7.75%) and salary rate to 4.50% (from 4.75%). Vacation buyback factor was increased from 1.00% to 1.25%. The pension increase adjustment base (COLA base) was increased to $13,000 (from $12,000).

As of January 1, 2011 the mortality assumption was changed to the RP 2000 Table projected forward 11 years with Scale AA.

As of January 1, 2010 the mortality assumption was changed to the RP 2000 Table projected forward 10 years with Scale AA, interest rate changed to 7.75% (from 8.00%).

As of January 1, 2009 the mortality assumption was changed to the RP 2000 Table projected forward 9 years with Scale AA, interest rate changed to 8% (from 7.75%), salary rate to 4.75% (from 5%), contribution timing changed to the beginning of the fiscal year from monthly.

Actuarial Methods and Assumptions (Continued)

	As of the January 1, 2008 valuation the retirement age assumption was extended to age 70 for Group 1 employees, disabled mortality changed to a 2 year set forward and the asset valuation method was changed to 5 year smoothing. As of the January 1, 2006 valuation the calculation of the 3(8)(c) liabilities did not reflect further COLA increases. As of the January 1, 2004 valuation, the retirement assumption for group 4 members was changed from retirement at age 58 and 10 years of service to retirement rates between ages 50 and 65. As of the January 1, 2003 valuation, the asset valuation method was changed to use a 15% corridor instead of a 10% corridor. Also, the pension adjustment base increase assumption was changed from 3% to 0%, the interest assumption from 8% to 7.75% and the salary assumption from 5.5% to 5%. As of January 1, 2002 an assumption regarding vacation buybacks was added. As of January 1, 2001 mortality has been changed from GAM94 to RP2000 to better reflect male mortality. As of January 1, 2000, mortality was changed from GAM83 to reflect longer life expectancies. The retirement age assumption was also changed. Prior to the January 1, 2000 valuation, employees of Groups 1 and 2 were assumed to retire at the later of age 63 and 10 years of service. Employees of Group 4 were assumed to retire at the later of age 56 and 10 years of service.
17. Date of Adoption	All assumptions and methods were adopted by the MPAERS Board on April 30, 2020 for use in the January 1, 2020 actuarial valuation and thereafter.
18. Contribution Timing	Contributions are assumed to be made at the beginning of the fiscal year, July 1.

Summary of Principal Plan Provisions

1. Participant

Participation is mandatory for all full-time employees whose employment commences before age 65. There are three classes of members in the retirement system:

Group 1: general employees

Group 2: employees in specified hazardous occupations (e.g., guards)

Group 4: firefighters and electricians

2. Member Contributions

Member contributions vary depending upon date hired as follows:

Date of Hire	Member Contribution Rate
Prior to 1975	5% of Pay
1975 - 1983	7% of Pay
1984 - June 30, 1996	8% of Pay
After June 30, 1996	9% of Pay

Chapter 697 provision requires members hired after 1978 to contribute an additional 2% of pay over $30,000.

3. Pay

a. Pay

Gross regular compensation excluding bonuses, overtime, severance pay, unused sick pay, and other similar compensation.

b. Average Pay

The average of pay during the three consecutive years (or five consecutive years if hired after April 1, 2012) that produce the highest average or, if greater, during the last three years (or five years if hired after April 1, 2012), (whether or not consecutive) preceding retirement.

4. Credited Service

Period during which an employee contributes to the retirement system plus certain periods of military service and "purchased" service.

Summary of Principal Plan Provisions (Continued)

5. Service Retirement

a. Eligibility

1) Attainment of age 55 and completion of ten years of credited service or at any age with completion of 20 years of service. If hired prior to 1978 or a member of Group 4, the completion of ten years of service is not required.

2) Hired after April 1, 2012 and Group 1 – Age 60 and Completion of 10 years of credited service. Group 2 – Age 55 and completion of 10 years of service. Group 4 – Age 55.

b. Retirement Allowance

Determined as the product of the member's benefit percentage, average pay and credited service, where the benefit percentage is shown below (maximum allowance of 80% of average pay):

Benefit Percentage	Group 1	Group 2	Group 4
2.5%	65+	60+	55+
2.4	64	59	54
2.3	63	58	53
2.2	62	57	52
2.1	61	56	51
2.0	60	55	50
1.9	59	N/A	49
1.8	58	N/A	48
1.7	57	N/A	47
1.6	56	N/A	46
1.5	55	N/A	45
	Hired after April 1, 2012*		
2.5%	67+	62+	57+
2.35	66	61	56
2.20	65	60	55
2.05	64	59	54
1.90	63	58	53
1.75	62	57	52
1.60	61	56	51
1.45	60	55	50

*Reduction is .125% for each year early instead of .15% per year for employees with over 30 years of service.

In addition, veterans receive an additional $15 per year for each year of credited service up to 20 years

Summary of Principal Plan Provisions (Continued)

6. Deferred Vested Retirement

a. Eligibility	Completion of ten years of credited service.
b. Retirement Allowance	Determined in the same manner as "Service Retirement" section above with the member eligible to start collecting a benefit at age 55, (or age 57 for post-April 1, 2012 hires) or defer until later at his or her discretion. If a member chooses, his or her contributions with interest may be withdrawn. The amount of interest he or she will receive depends on length of service and whether or not the termination of employment was voluntary.

7. Ordinary Disability Retirement

a. Eligibility	Non-job related disability after completion of ten years of credited service.
b. Retirement Allowance	Determined in the same manner as "Service Retirement" section and calculated as if the member had attained age 55 (or age 57 for those hired after April 1, 2012), if younger. Veterans receive 50% of pay (during final year) plus an annuity based on accumulated member contributions with interest.

8. Accidental Disability Retirement

a. Eligibility	Disabled as a result of an accident in the performance of duties. No age or service requirement.
b. Retirement Allowance	72% of pay plus an annuity based on accumulated member contributions with interest. Also, a dependent's allowance per year for each child. Total allowance not to exceed 100% of pay (75% for members hired after 1987).

Summary of Principal Plan Provisions (Continued)

9.	Non-Occupational Death		
	a.	Eligibility	Dies while in active service, but not due to occupational injury.
	b.	Retirement Allowance	Benefit as if Option C had been elected (see below) and member had attained age 55 (or age 57 for those hired after April 1, 2012) if younger. Minimum monthly benefits provided as follows: spouse - $500, first child - $120, each additional child - $90
10.	Occupational Death		
	a.	Eligibility	Dies as a result of an occupational injury.
	b.	Retirement Allowance	72% of pay plus refund of annuity savings fund balance. In the case of an accidental disability retiree who dies of the same cause, the beneficiary receives 72% of the last 12 months salary or the current pension amount, whichever is greater.
11.	Cost-of-Living Increases		Applied to the first $14,000 of annual benefit. Funded by the Authority.
12.	Optional Forms of Payment		
	a.	Option A	Allowance payable monthly for the life of the member.
	b.	Option B	Allowance payable monthly for the life of the member with a guarantee of any remaining member contributions with interest.
	c.	Option C	Allowance payable monthly for the life of the member with 66-2/3% continuing to the member's beneficiary upon the member's death. If the beneficiary pre-deceases the member, the allowance amount "pops-up" to the non-reduced amount (Option A).

Glossary of Terms

1. Present Value of Future Benefits - Represents the dollar value today of all benefits expected to be earned by current members if all actuarial assumptions are exactly realized.

2. Actuarial Cost Method - The procedure used to allocate the Present Value of Future Benefits to past and future periods of employee service.

3. Actuarial Assumptions - Estimates are made as to the occurrence of certain events that determine the level of benefits to be provided and how long they will be provided. The more important actuarial assumptions include the investment return on assets, salary increases and the rates of turnover, disability, retirement and mortality.

4. Unfunded Frozen Actuarial Liability - The liability set under the Entry Age Actuarial Cost Method at plan inception, adjusted at each valuation to reflect the addition of interest and the amortization of liability since the previous valuation. The amount is adjusted by any increases or decreases in the actuarial liability (determined under the Entry Age Method) due to changes in benefits or actuarial assumptions after plan inception.

5. Normal Cost - That portion of the Present Value of Future Benefits that is attributable to benefits to be earned in the coming year. Under the Frozen Entry Age Method, the Normal Cost is the portion of the Unfunded Present Value of Future Benefits which is not attributable to the Unfunded Frozen Actuarial Liability. This amount is then funded as a level percentage of pay.

6. Actuarial Value of Assets - Value of the funds set aside through Authority and member contributions to provide for benefits, as measured by the actuary for valuation purposes.

7. Unfunded Present Value of Future Benefits - That portion of the present value of Future Benefits, not covered by the Actuarial Value of Assets.

8. PERAC - Public Employee Retirement Administration Commission, a division of the State government which has regulatory authority over the administration of the retirement system.

9. GASB - Government Accounting Standards Board, which issues guidance for disclosure of retirement system liabilities.